

Ecole Doctorale des Sciences Fondamentales

Title of the thesis: Durability of phosphors embedded in lighting devices: evaluation, degradation mechanisms and protection strategies.

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Summary :

Lighting devices based on LEDs are nowadays of great interest owing to their long life and low electrical power consumption. Guarantying the long term performances of these devices to the customers requires qualifying with care the lifetime of the phosphor layers that are embedded in the LED packages. Under operating conditions, these luminescent layers are subject to several types of stresses (temperature, photons, humidity, VOCs, etc...) for thousands of hours, which may cause premature degradation and concomitant loss of optical performance. It is the purpose of the present research project to evaluate the degradation kinetics of these phosphors in the form of inorganic, organic or organic-inorganic hybrid powders and also polymer-based composite films. This will be achieved by using a specific prototype that will be conceived and built in the laboratory. This prototype will be designed in a way such that the temperature, the atmosphere and the incoming irradiation power experienced by the phosphor can be controlled in a remote mode. The setup will also allow the automatic collection of luminescence spectra over long periods of time. The aim is to extract the involved kinetics laws that will permit an extrapolation of the optical behaviours to thousands of hours. The second objective of the research work is to identify the origin of the degradation by investigating the luminescence depreciation mechanisms. This will be done by using local probing techniques like photoluminescence, ESR, NMR, XPS, etc... From this diagnosis, it will be possible to elaborate a strategy for the protecting the phosphors from the typical stresses that they are experiencing in LEDs packages.